

## Is Engineering Education Research Global? The Answer May Surprise You.

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# Is Engineering Education Research Global? The Answer May Surprise You.

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## Introduction

There has been an increasing focus on the globalization of Engineering Education Research (EER) in recent years and recognising this, in 2007 the editors of the *Journal of Engineering Education (JEE)* and the *European Journal of Engineering Education (EJEE)*, Jack Lohmann and Jean Michel, respectively, launched a worldwide initiative called *Advancing the Global Capacity for Engineering Education Research*. In a resulting paper published jointly by *EJEE* and *JEE* in 2010 (Jesiek, Borrego & Beddoes, 2010), it was suggested that “the field of engineering education research is going global” and Jesiek and colleagues went on to propose a model whereby engineering education scholarship could advance locally and globally via cycles of translation and enrolment which would connect local practice and contexts with a global core of knowledge. These authors encouraged EER practitioners to “look for opportunities to translate research questions, theories, methods, and findings so they are readable and relevant across national and institutional boundaries” and urged scholars to “think globally about the development of engineering education as a research field, while acting locally to enrol new actors and perform context-sensitive translations”.

In a similar vein, Alan Cheville, in a talk posted on IEEE TV, stresses the importance of research into global competencies to assist engineering educators “to make our students into better global citizens” (Cheville, 2012).

However, an analysis of empirical research in leading EER journals up to 2008 (Jesiek et al., 2011) showed that the majority of published authors in the analysed articles came from the US (36%) with the EU and Australia providing 29% and 23% respectively and the level of international co-authorship was relatively low at 8%. Although we might assume that in the intervening years this trend might have diminished due to increased globalization, we note that a recently published list of the most collaborative co-authors in EER (Strobel et al 2012) contains only US scholars. Furthermore, a recent analysis of 24,172 papers in engineering education research journals and conference proceedings over the period 2000-2011 (Xian and Madhavan, 2014) has found that in-state collaboration within the US is significantly more frequent than between-state collaboration which suggests that geographical location can strongly influence how scholars form collaborations.

The three empirical studies above focused on the most published authors and those with whom they co-authored but do not provide information on what sources these scholars consulted when carrying out

their work. Even if published research in the principal journals and conferences in the field does come predominantly from US authors, these researchers may nevertheless be becoming more global in their outlook and be considering global sources in their research. One credible way of detecting such a trend is to analyse the sources cited by authors and that is one of the approaches adopted here. This perspective is in line with a 2011 position paper by Borrego and Bernhard who suggest that “EER has emerged as an internationally connected field of inquiry” and go on to describe the U.S. and Northern and Central European approaches to EER as “two examples of the diversity of approaches”( Borrego and Bernhard, 2011). These authors set out six criteria for quality scholarship in engineering education in an international context. We selected the second of these criteria, that quality scholarship should be “informed by theory and other literature describing prior work within and beyond the field/home country” as an indicator which should be susceptible to empirical measurement by studying citation patterns of publications of leading journals in the field. We note that when such an analysis was carried out for articles in JEE from 1993 to 2002 (Wankat, 2004) the list of 33 of the most highly cited source authors contained 32 US-based scholars and 1 from Canada.

## **Methodology and Procedure**

To what extent has EER become global? To test such a claim we hypothesized that author and citation data from US and European journals would demonstrate globalization. In other words, the affiliations of the authors in the journals would show a global rather than local spread (taking Europe as a whole for the study) and also that the pool of sources the authors cite would be global.

Given that *JEE* and *EJEE* are highly cited journals published respectively by the American and European Societies for Engineering Education and that they participated jointly in the 2007 *Advancing the Global Capacity for Engineering Education Research* initiative, the authors chose *JEE* as a representative of US and *EJEE* of European EER journals. Author affiliations were collected for all authors from the 2010 through 2013 issues. In addition, a list of frequently cited sources was developed, and the country of professional affiliation for each source was determined. We initially started with the list of 33 frequently cited sources in *JEE* published in 2004 (Wankat, 2004) and added source names from the October 2013 list of the most highly-cited *EJEE* papers (maintained on the publisher’s website). Then we added to this list other frequently cited authors found when manually analysing the reference list of each journal articles. The sources were separated into three groups based on geographic location: US, Europe, and Other (all other countries). Citations were counted from regular papers (excluding editorials, guest editorials, and book reviews) and self-citations were not included. The cited authors in each journal were ranked according to the number of times they were cited. Wankat’s 2004 study listed the 33 most frequently cited sources and we have taken a similar approach in this paper and compiled the sources in *JEE* cited 17 or more times while for *EJEE* we took 8 or more citations as the cut-off point. This produces lists of 34 and 35 respectively as shown in Tables 1 and 2 below.

## **Results**

There were 109 *JEE* articles with a total of 395 authors over the 4 years in question while *EJEE* published 204 articles with 529 authors. The distribution of the affiliations of these authors is shown in Figure 1.

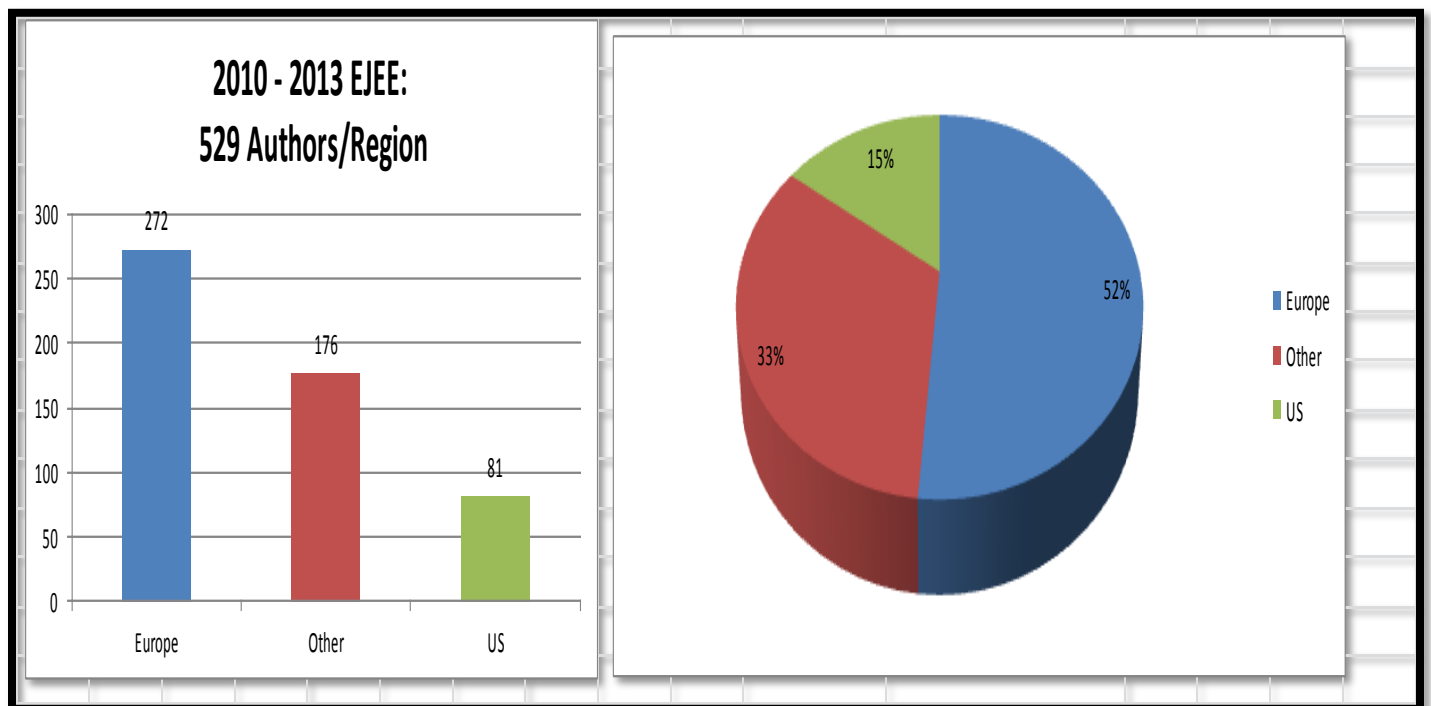
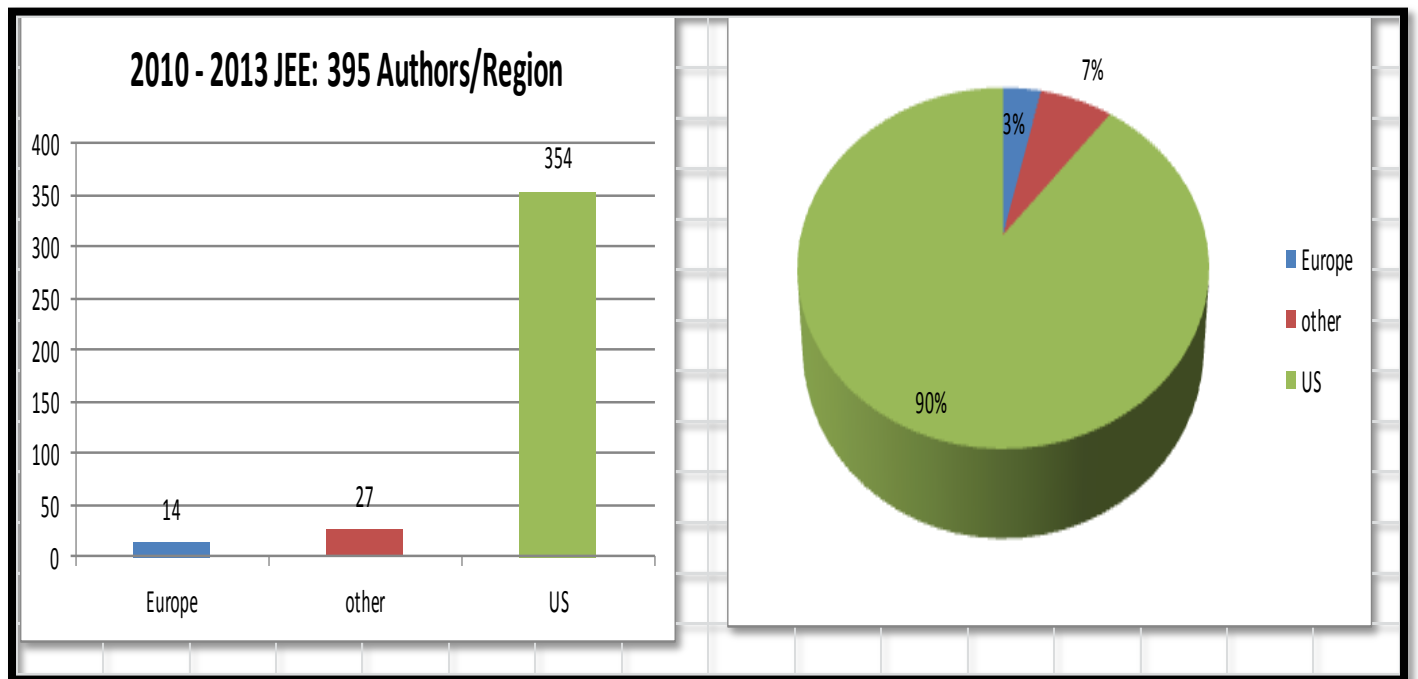


Figure 1: Affiliation distribution of authors in *JEE* and *EJEE* articles (2010 – 2013)

EJEE Sources			
Rank	Author	Region	Citations
1	Felder, R M	US	55
2	Kolmos, A	Europe	35
3	Johnson, DW & RT	US	27
4	Smith, K	US	26
5	ABET	US	22
6	Brent, R.	US	22
7	Biggs, J.	Europe	17
8	De Graaff, E	Europe	16
9	Trevelyn, J	Other	15
10	Marton, F	Europe	14
11	Atman, C	US	13
12	Borrego, M	US	13
13	Kolb, D A	US	13
14	NSF	US	13
15	UNESCO	Europe	12
16	Woods, D R	Other	12
17	Miller, R	US	12
18	Sheppard, S	US	12
19	Baillie, C	Other	11
20	Prince, MJ	US	11
21	Lindsay, E	Other	10
22	Gardner, A	Other	10
23	Alpay, E	Europe	9
24	Dym, CL	US	9
25	Stice, J	US	9
26	Besterfield-Sacre, M.	US	9
27	Lohmann J	US	9
28	Gill, J	Other	8
29	Willey, K	Other	8
30	ASEE	US	8
31	Eccles, J. S.	US	8
32	Jonassen, D H	US	8
33	Ohland, M	US	8
34	Olds, B	US	8

Table 1: Highly cited source authors in *EJEE* (2010 – 2013)

JEE Sources			
Rank	Author	Region	Citations
1	Felder, RM	US	63
2	NAE	US	58
3	Sheppard, S	US	57
4	Atman, C	US	48
5	Johnson, DW & RT	US	43
6	Smith, K	US	40
7	Besterfield-Sacre, M.	US	37
8	Bandura, A	US	36
9	Shuman, L	US	34
10	Eccles, J	US	32
11	Olds, B.	US	32
12	Terenzini TP	US	31
13	Latucca, L	US	31
14	Miller, R	US	30
15	NSF	US	30
16	Brent, R.	US	29
17	Ohland, M.	US	28
18	Seymour, E	US	28
19	Bransford	US	27
20	Adams, R	US	25
21	NRC	US	25
22	Prince, M.J.	US	24
23	Streveler, R.	US	24
24	Litzinger T	US	22
25	Newstetter, W	US	22
26	Agogino, A	US	21
27	Borrego, M	US	21
28	Simon, H	US	21
29	ABET	US	20
30	Astin, A W	US	20
31	Hewitt, N	US	20
32	Cross, N.	Europe	19
33	Dym, C L	US	19
34	Johri, A	US	17
35	Vygotsky, LS	US	17

Table 2: Highly cited source authors in *JEE* (2010 – 2013).

Note: since the Johnson brothers normally publish together, they are treated as a single source.

## Findings

Whereas affiliations of EJEE authors were fairly evenly distributed around the globe albeit with a preponderance of European researchers over those from the US, Australia, Brazil and South Africa, almost 90% of JEE authors were from the US. This is in accord with a historical study of the affiliations of authors in JEE and EJEE over 40 years from 1973 to 2013 that showed that while EJEE has traditionally published work by a broadly global set of authors, JEE authors have tended to be almost exclusively North American based (Wankat et al. 2014).

Table 2 shows that citations in *JEE* are dominated by sources with US affiliations, which does not support our hypothesis. On the other hand, the EJEE data (Table 1) show that while US sources are frequently cited, European and Other authors are also well represented. The short answer to our title question is that in citation terms, European EER is global but US EER not.

The data in Table 2 also reveal a number of other interesting observations. For example, of the 33 top sources on the original *JEE* list (Wankat, 2004) only 14 occur in the top 33 in Table 2 (Felder, Sheppard, Atman, Johnson & Johnson, Smith, NSF, Olds, Seymour, Hewitt, Astin, Agogino, ABET, and NRC) - *sic transit gloria mundi*. R. Felder tops both our lists as indeed he did in Wankat's 2004 list of most-cited authors (Wankat 2004). Some US authors such as D. Kolb and M. Borrego are relatively better known in Europe than in the US, and some European authors such as N. Cross are better known in the US than in Europe. Regional differences are clear in some cases – for example, the National Academy of Engineering (NAE) is heavily cited in *JEE* but only twice in *EJEE*, and UNESCO is significantly cited in *EJEE* but was not cited in *JEE*. On the other hand, ABET was heavily cited in both *JEE* and *EJEE*.

One anomaly was observed. If one searches on the *EJEE* and *JEE* websites for Benjamin Bloom of taxonomy fame, there are a large number of hits. Despite this, the number of citations of Bloom did not make the cut off for either journal (17 in *JEE* and 8 in *EJEE*). Many authors discuss Bloom's Taxonomy without citing it. Apparently the taxonomy has become such a normal part of discourse in EER that many authors believe no citation is needed.

## Conclusions

Whereas the authors published in *EJEE* and the sources they consult when carrying out their research are drawn globally, this is not the case for scholars published in *JEE*. If the EER community is to aspire to the kind of quality scholarship characterized by Borrego and Bernhard (2011) there needs to be debate around how such issues can be tackled so as to develop a truly global field of research.

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